# The Geospatial Distribution of Storm Based Tornado Warnings

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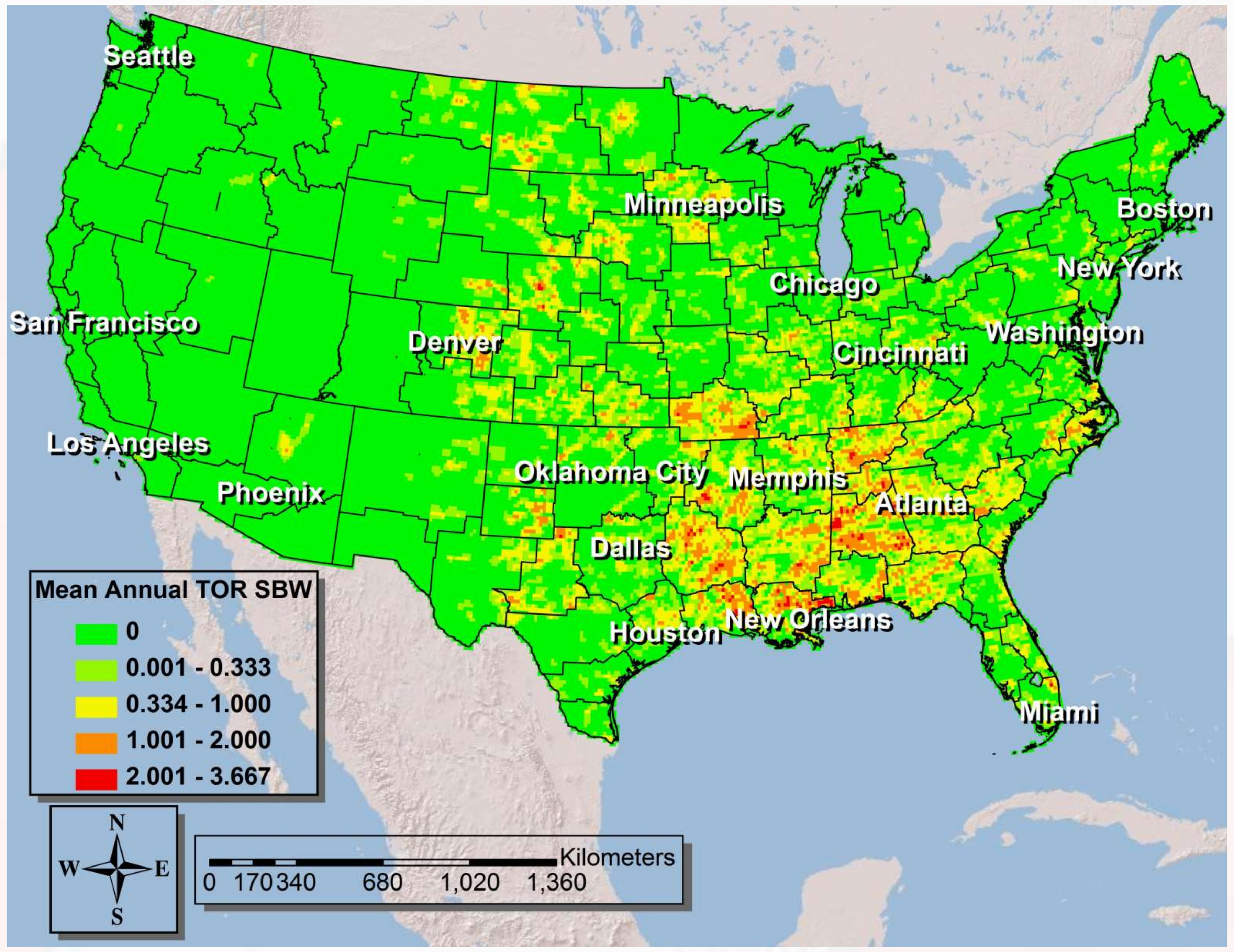
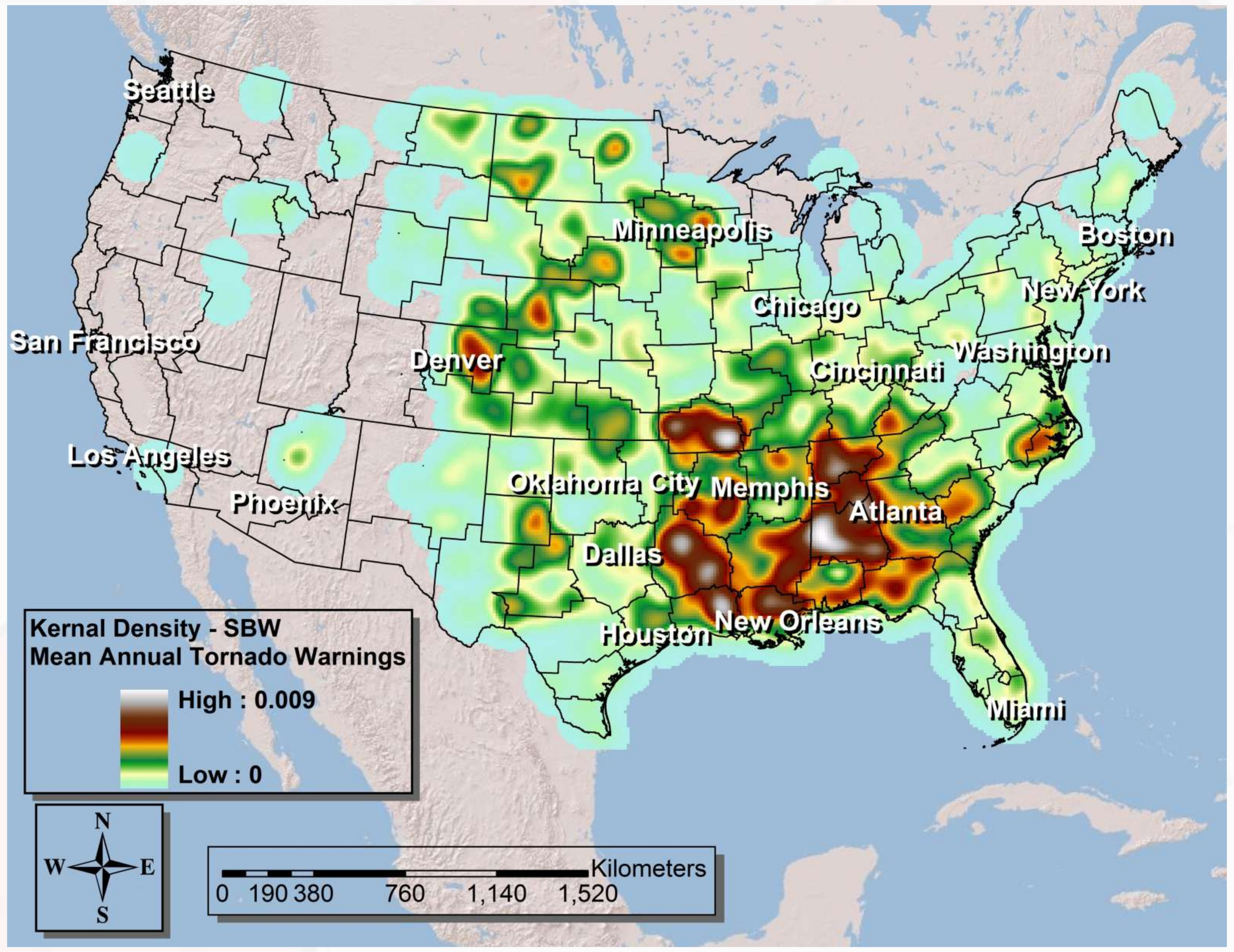
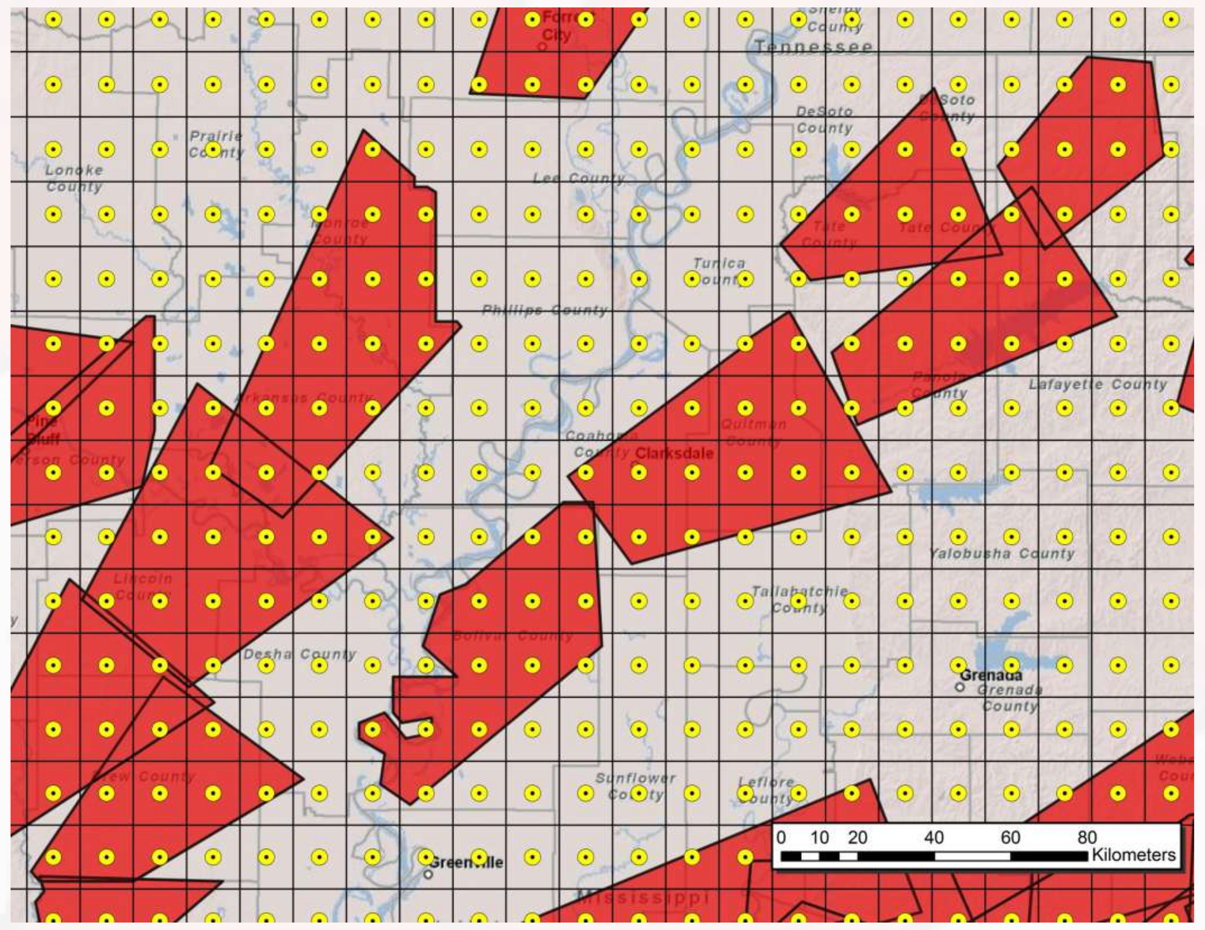
The purpose of this study is to determine the spatial and directional distribution of storm based polygon tornado warnings. The spatial distribution of warnings can reflect the actual tornado climatology or provide an indication of over-warning. The directional distribution of warnings in relation to the geographic center of a county warning area can be an indication of predominant severe storm movement, storm genesis locations within the county warning area, extent of radar coverage, or a signal of the tendency of the local weather forecast office to warn for storms that may approach major population centers.

Storm based warnings issued from 2008 to 2010 for the contiguous United States were analyzed using Geographic Information System (GIS) techniques. These data were compared to county based warning data from 1996 to 2006. The polygon warning data were spatially joined to the US Geological Survey's 7.5 minute, 1:24,000 (1:25,000 metric) Quadrangle Series to provide a consistent method of spatial representation of both county and storm based short-fuse warnings. Kernel density analyses were performed to smooth the data and provide a visual representation of the spatial distribution of mean annual warnings. The mean center and directional distribution of warnings for each county warning area were calculated using GIS tools and grouped according to climate region.

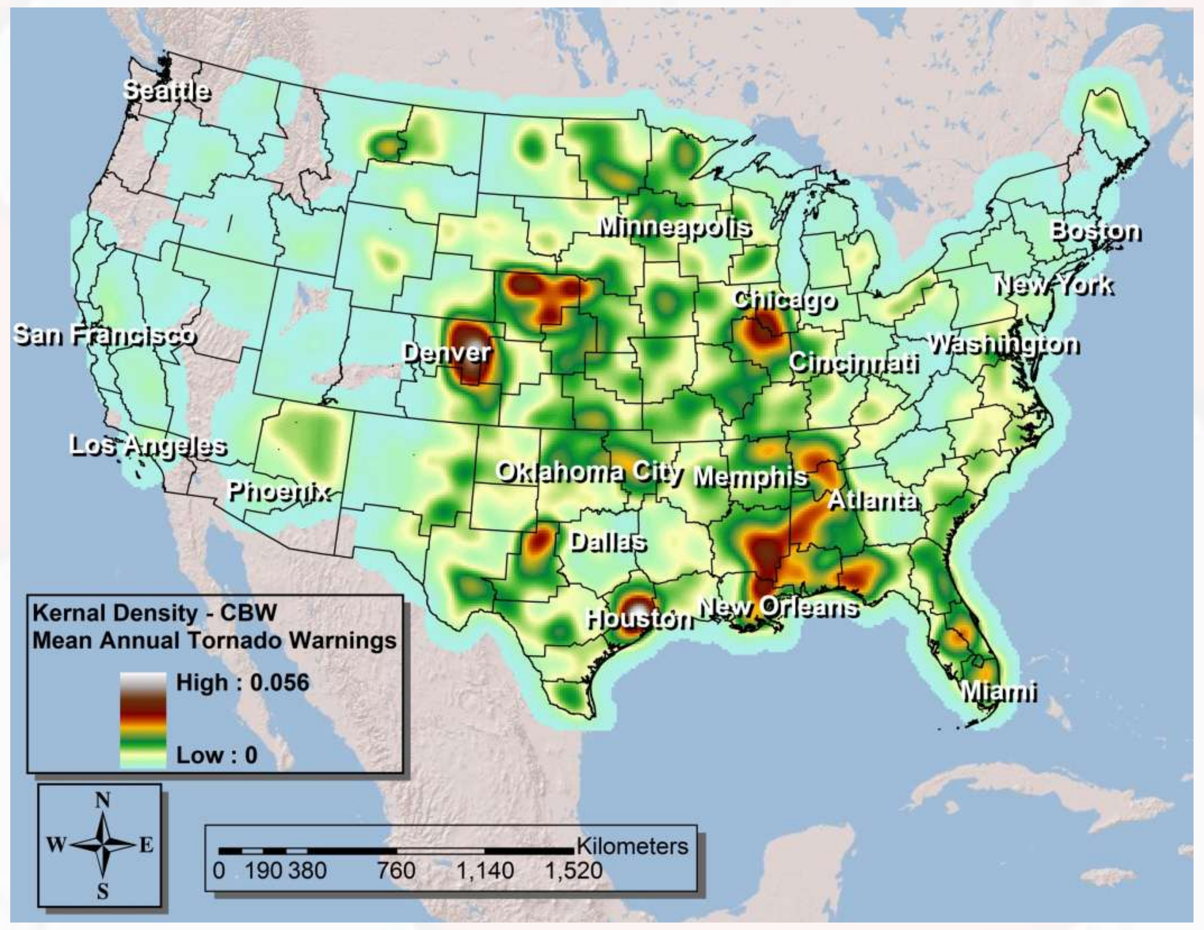
Results show that the highest annual average numbers of storm based warnings are issued in the "Dixie Alley" southeastern region of the nation. This distribution is especially apparent when compared to county based warnings, although far fewer storm based warnings are issued. Directional distribution results show no consistent overall pattern, and vary according to county warning area. Although the methods are limited by the relatively short time frame of the dataset, results provide an indication of the overall annual and monthly spatial pattern of tornado warnings.

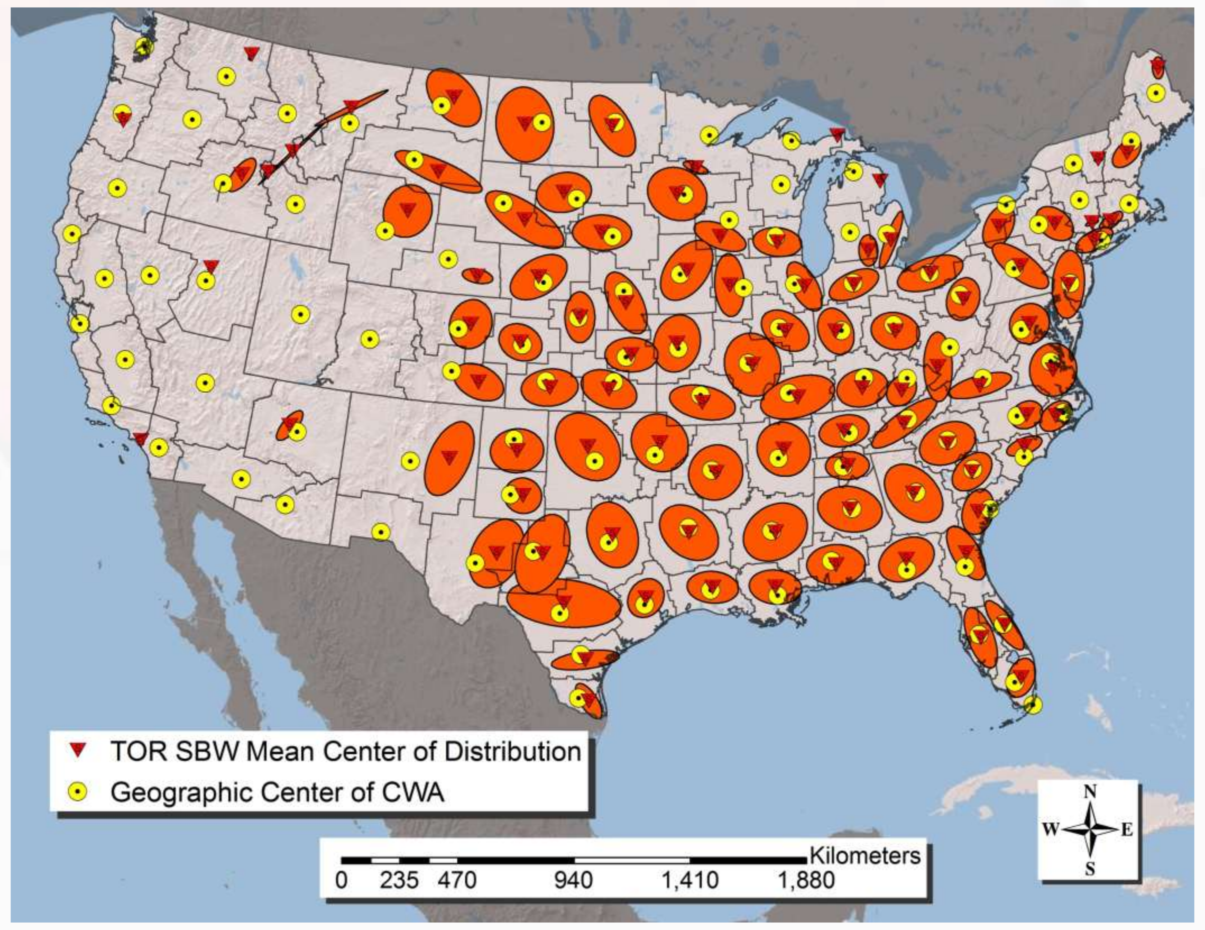


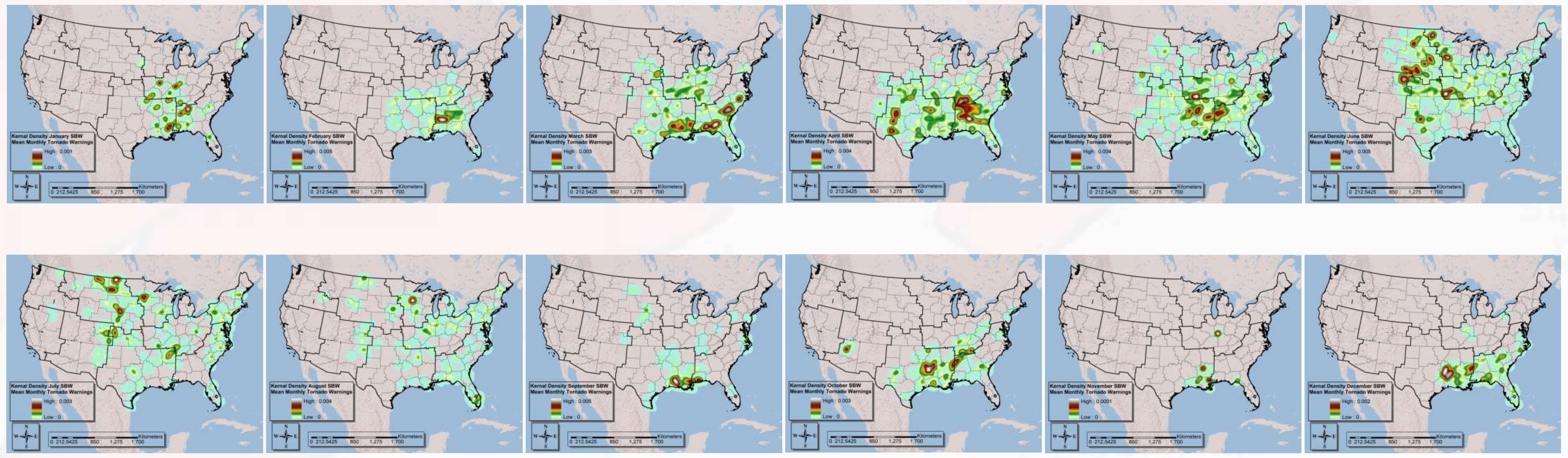



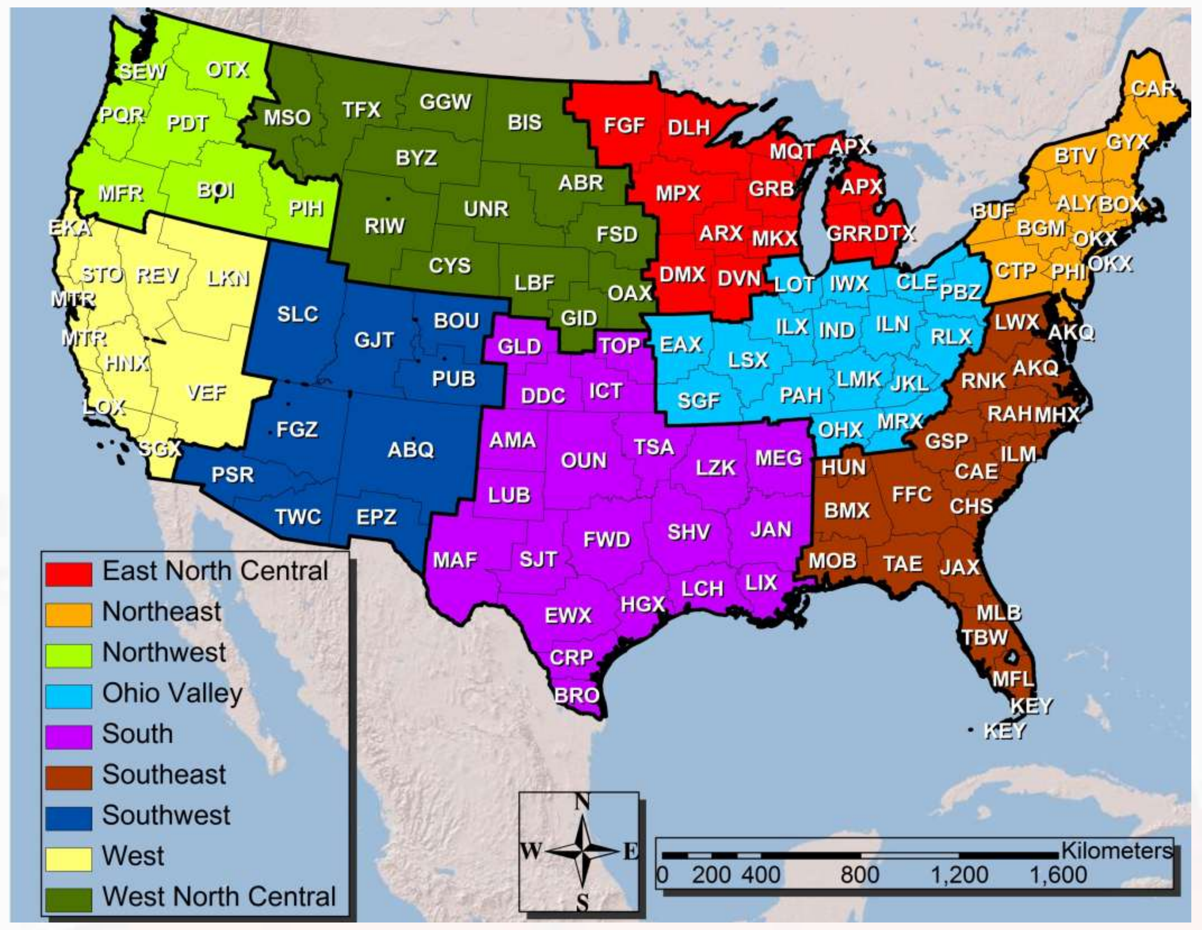

Example of GIS Spatial Join Method




Monthly Averages






| ENC WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| APX | 114.69 | 117.59 | 10 |
| ARX | 76.62 | 211.49 | 6 |
| DLH | 142.62 | 205.12 | 8 |
| DMX | 31.41 | 63.49 | 3.5 |
| DTX | 29.73 | 155.00 | 8 |
| DVN | 57.12 | 284.37 | 5 |
| FGF | 18.72 | 216.95 | 1 |
| GRB | NA | NA | NA |
| GRR | 105.40 | 141.81 | 8 |
| MKX | 24.89 | 165.05 | 2 |
| MPX | 26.86 | 274.26 | 3.5 |
| MQT | 184.16 | 88.85 | 11 |

| WNC WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| ABR | 57.35 | 294.27 | 3 |
| BIS | 69.30 | 260.00 | 4.5 |
| BYZ | 108.82 | 109.84 | 6 |
| CYS | 137.57 | 114.59 | 13 |
| FSD | 45.14 | 288.86 | 4.5 |
| GGW | 58.89 | 51.49 | 7.5 |
| GID | 7.08 | 81.31 | 1.5 |
| LBF | 28.24 | 314.51 | 1.5 |
| MSO | 157.60 | 159.76 | 10.5 |
| OAX | 50.06 | 169.63 | 12 |
| RIW | 120.78 | 40.77 | 9 |
| TFX | 61.01 | 356.45 | 7.5 |
| UNR | 110.12 | 123.95 | 10.5 |

| NE WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| ALY | 106.24 | 165.31 | 7 |
| BGM | 64.83 | 100.79 | 5 |
| BOX | 102.09 | 241.94 | 6 |
| BTV | 101.93 | 95.03 | 8.5 |
| BUF | 92.24 | 210.26 | 10 |
| CAR | 101.26 | 22.31 | 8.5 |
| CTP | 28.89 | 79.92 | 2.5 |
| GYX | 51.42 | 216.63 | 4 |
| OKX | 28.53 | 285.69 | 2.5 |
| PHI | 9.49 | 247.09 | 1 |

| NW WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| BOI | 81.95 | 52.48 | 3 |
| MFR | NA | NA | NA |
| OTX | 133.71 | 36.26 | 4 |
| PDT | NA | NA | NA |
| PIH | 169.40 | 308.95 | 2 |
| PQR | 29.66 | 152.60 | 1 |
| SEW | NA | NA | NA |

| OV WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| CLE | 3.93 | 126.63 | 1.5 |
| EAX | 21.44 | 345.78 | 1.5 |
| ILN | 27.78 | 172.54 | 12.5 |
| ILX | 28.51 | 121.95 | 9 |
| IND | 22.95 | 269.57 | 11 |
| IWX | 9.61 | 160.83 | 3 |
| JKL | 53.51 | 212.13 | 12.5 |
| LMK | 41.13 | 195.70 | 7 |
| LOT | 42.46 | 109.07 | 15 |
| LSX | 18.45 | 113.83 | 7 |
| MRX | 22.55 | 225.36 | 5 |
| OHX | 21.22 | 296.95 | 7 |
| PAH | 39.94 | 118.78 | 14 |
| PBZ | 23.37 | 153.44 | 4 |
| RLX | 92.24 | 220.59 | 16 |
| SGF | 31.91 | 167.37 | 10 |

| S WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| AMA | 48.32 | 161.20 | 20 |
| BRO | 43.02 | 106.16 | 13 |
| CRP | 29.44 | 137.65 | 11.5 |
| DDC | 30.43 | 146.52 | 17 |
| EWX | 44.00 | 18.39 | 4 |
| FWD | 35.19 | 26.77 | 8.5 |
| GLD | 11.90 | 320.89 | 3 |
| HGX | 26.95 | 12.22 | 2 |
| ICT | 36.52 | 211.94 | 18.5 |
| JAN | 16.48 | 115.93 | 5 |
| LCH | 14.88 | 42.99 | 1 |
| LIX | 34.92 | 348.69 | 18.5 |
| LUB | 51.34 | 91.99 | 15 |
| LZK | 19.28 | 121.87 | 6.5 |
| MAF | 94.07 | 61.33 | 21 |
| MEG | 42.59 | 36.72 | 14 |
| OUN | 63.80 | 333.93 | 8.5 |
| SHV | 21.47 | 173.65 | 10 |
| SJT | 39.10 | 103.77 | 11.5 |
| TOP | 23.93 | 66.85 | 6.5 |
| TSA | 53.42 | 23.06 | 16 |

| SE WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| AKQ | 35.50 | 175.12 | 16.5 |
| BMX | 8.05 | 260.19 | 5.5 |
| CAE | 11.76 | 199.47 | 5.5 |
| CHS | 49.21 | 265.96 | 10 |
| FFC | 10.79 | 255.28 | 1.5 |
| GSP | 14.64 | 188.75 | 7 |
| HUN | 17.98 | 86.98 | 16.5 |
| ILM | 42.88 | 11.88 | 10 |
| JAX | 54.43 | 12.62 | 14 |
| LWX | 40.97 | 68.16 | 16.5 |
| MFL | 30.58 | 65.69 | 12.5 |
| MHX | 32.38 | 256.38 | 10 |
| MLB | 7.72 | 138.94 | 1.5 |
| MOB | 23.94 | 136.32 | 3 |
| RAH | 39.45 | 95.57 | 16.5 |
| RNK | 32.21 | 211.04 | 12.5 |
| TAE | 41.21 | 5.84 | 8 |
| TBW | 15.06 | 157.10 | 4 |

| SW WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| ABQ | 158.12 | 80.21 | 1.5 |
| BOU | 53.02 | 65.00 | 1.5 |
| EPZ | NA | NA | NA |
| FGZ | 38.98 | 301.08 | 3 |
| GJT | NA | NA | NA |
| PSR | NA | NA | NA |
| PUB | 118.95 | 106.66 | 4 |
| SLC | NA | NA | NA |
| TWC | NA | NA | NA |

| W WFO | Distance | Azimuth | Performance |
|---|---|---|---|
| EKA | NA | NA | NA |
| HNX | NA | NA | NA |
| LKN | 54.46 | 10.48 | 1.5 |
| LOX | NA | NA | NA |
| MTR | NA | NA | NA |
| REV | NA | NA | NA |
| SGX | 77.23 | 277.73 | 1.5 |
| STO | NA | NA | NA |
| VEF | NA | NA | NA |

Distance in Kilometers, Azimuth in Directional Degrees

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